996,056

PATENT SPECIFICATION

DRAWINGS ATTACHED

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Int. Cl.:—F 04 d//F 06 d, F 24 f

COMPLETE SPECIFICATION

Blower

We, PHILIPS ELECTRONIC AND ASSOCIATED INDUSTRIES LIMITED (formerly Philips Electrical Industries Limited), a British Company, of Abacus House, 33 Gutter Lane, London, E.C.2. do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

THE INVENTION relates to blowers and particularly but not exclusively to blowers incorporating an electric heating element and designed to be used for domestic room air-warming purposes.

The principal requirement of blowers intended for domestic use, as for example in air-extraction apparatus for forced ventilation, circulating air for cooling purposes during hot weather and space heaters for use during cold weather, is silence in operation.

For certain industrial purposes, for example grain drying, silence is not particularly important but blowers for these purposes should in general be as efficient as possible and product a steady substantially non-turbulent air stream.

Secondary requirements of domestic blowers, particularly those intended to space heating, the so-called "fan heaters" are small size for a given heat output, efficient warming of the air stream, small temperature rise of the casing during operation and safety both mechanically and electrically.

From the production point of view it is desirable that blowers of both industrial and domestic types should be built up of parts which are relatively simple to fabricate and assemble. Further, rotating parts should preferably be simply fabricated so that no static, dynamic or aero-dynamic balancing problems arise.

According to the present invention there is provided a blower comprising a duct having a semi-cylindrical portion and a portion defining an outlet throat extending along the whole or substantially the whole of the length of the duct, two spaced co-axial fans mounted for rotation co-axially with the semi-cylindrical portion of the duct and each adjacent an end of the duct for producing two gas streams each of which has a combined longitudinal and rotational movement, the rotational movements being in the same sense and the longitudinal components towards one another, the combined streams leaving the duct substantially tangentially to the said two gas streams through the outlet throat, and at least one prime mover for rotating the fans in the same direction.

By the term "gas" is meant any gaseous medium including air.

By suitable "handing" of the blades each fan draws a gas stream into the duct where the longitudinal component of each stream is converted into a rotational component so that the streams combine and emerge from the throat with substantial velocity. Further the stream in front of the throat tends to converge slightly thus producing a focusing effect. This is of value particularly when the air is heated since it produces a region of warmth of suitable extent at a distance in front of the blower.

Experiments have shown that a blower arrangement of the above-described kind is very quiet in operation and it is thought that this is in part due to the opposed gas streams and in part to the fact that the duct as a silencer tending to cause or permit damping of any audible frequency vibrations imparted to the entrant gas by the fans before combined gas stream emerges from the duct.

Other features of the invention will be apparent from the following description of a

fant heater which is given by way of example only with reference to the accompanying drawings in which

Figure 1 is a front elevation of a fan heater,

Figure 2 is a perspective view of a blower and heater assembly,

Figure 3 is a plan view of the motor-fan assembly detached from its casing,

Figure 4 shows a flexible coupling to an enlarged scale,

Figure 5 is an end view on the line 5—5 of Figure 1,

Figure 6 is an end view on the line 6—6 of Figure 1,

Figure 7 is an end elevation of the heater shown in Figure 1 and

Figure 8 is a section of the end cover of the heater casing on the line 8—8 of Figure 7.

Referring now to the drawings a fan heater incorporating a blower according to the invention is shown in front elevation in Figure 1. An outer casing 1 of wrap-around form defines a front rectangular aperture within which is secured a protective grille 2 through which the outlet air emerges. The front face of the casing carries switches 3 for controlling the operation of the blower motor and the heater elements to be described hereinafter.

The blower proper is shown in perspective in Figure 2. It comprises essentially a duct or wind tunnel 4 open at both ends and of substantially snail shape cross-section, that is, having a semi-cylindrical portion 30 and a non-cylindrical portion 31 defining an outlet throat. The duct is most conveniently fabricated by bending a rectangular metal sheet to the required form. The stiffness of the duct may be increased by spaced indentations or ribs 5. One end of the sheet is outwardly turned to form a flange 6 spaced from the other end of the sheet to define with the portion 31 an outlet throat of rectangular cross section.

Within the duct is mounted a motor-fan assembly as shown in Figure 3. The motor 7 is preferably of the shaded pole type for use on A.C. mains but may, of course, be of any suitable type depending on the duty and the supply current available. The motor rotor has bearings 8, 9 carried in bridge pieces secured to the motor lamination block and a similar pair of bearings 10, 11, which may be of the self-centering oil impregnated type, are carried at the outer ends of rods 12, 13 by similar bridge pieces. The rods 12, 13 pass through and are secured in any convenient manner, as for example by an interference fit, in the lamination block.

Multi-bladed fans 14, 15 are secured to half-shafts 16, 17 respectively, journalled, in the bearings 10, 11 each of which shafts is connected to the motor shaft 18 by a resilient coupling 19, 20. The shafts about which the fans rotate extend co-axially with respect to the semi-cylindrical portion of the duct. One of the couplings 19, 20 is shown in a preferred form in section in Figure 4 and comprises a cylindrical sleeve of resilient material for example rubber having a smaller internal diameter in the free state than the shafts. The motor shaft 18 is provided with a peripheral groove 22 and each fan half-shaft 16 (17) with a similar groove 21. The resilient sleeve is first expanded by a suitable tool and engaged with the shaft 18. Withdrawal of the tool permits resilient contraction of the sleeve so that it grips the shaft and makes a firm connection therewith by engaging the relatively deep groove 22. The sleeve is then forced on to the shaft 16 (17) over the groove 21 a resilient spacer 23 being provided, if desired, between the ends of the shafts. In this way a resilient connection is provided between the shafts which accommodates any slight misalignment or vibration in operation. As can be seen in Figure 4 the sleeve 19, 20 grips the groove 22 more snugly than the groove 21 so that the shafts 16, 17 may be more readily detached from the couplings than the motor shaft 18. This feature is useful for assembly and servicing operations.

The fans 14, 15 in the example shown are six-bladed, the fans being bent up from a flat circular sheet of metal. We have found that flat vanes twisted to an angle of approximately 50° from the flat sheet give a satisfactory air stream having the desired longitudinal and rotational components and lack of noise in operation. Other shapes and angle of twist and numbers of blades may of course be chosen depending on particular circumstances and fans of other material than metal, for example synthetic material may be employed. In this case the fans can be fabricated, for example by a moulding operation, one suitable material being nylon.

The complete motor-fan assembly shown in Figure 3 may be mounted within the duct 4 by securing the motor body in the duct by suitable means, for example a bracket (not shown), the duct being apertured as shown in Figures 2 and 5 to permit the coil assembly with its terminal connections to protrude therethrough into the space between the duct 4 and the casing 1 (see Figure 5). Resilient means may be incorporated in the mounting to prevent the duct acting as a sounding board for mechanical vibrations emanating from the motor-fan assembly.

The fans are so "handed" that each draws aid into the duct with the correct direction of rotation (clockwise in Figures 5 and 6) to cause the air to leave the outlet throat substantially tangentially to the lower portion of the fan.

The air heating resistance elements are

supported at their ends by ceramic plates 24, 25 and intermediately by ceramic plates 26, 27. The plates 24 and 25 have projections on their upper and lower edges engaging slots in the ends of the flange 6 and the side edges of the lower wall of the duct (see Figures 2 and 6) these plates being maintained in position by the natural resilience of the coil heating elements until the assembly is placed within the outer casing. The intermediate plates 26, 27 may also engage similar slots in the side edge of the flange 6 and the front edge of the lower part of the duct to maintain them in position at the correct distance apart.

This blower-heater assembly may be introduced into the outer casing through one end thereof and secured in position by self-tapping screws or screws passing through holes in the case of the outer casing and engaging threaded bosses 28 (Figure 6) formed in or secured to the duct.

The back of the casing may be provided with "key-hole" shaped slots (not shown) to enable the apparatus to be hung on a wall. Alternatively or in addition, as shown in Figure 1, legs may be provided to raise the apparatus off the supporting surface. These legs are preferably readily detachable to enable the apparatus to be more easily packed for transit.

The electrical connections between the switches and the heater element and motor may be effected before the blower-heater assembly is introduced into the outer casing, the final assembly being completed before the end cover shown in Figures 7 and 8 is placed in position. This cover and a similar coevr at the other end of the casing 1 may be secured thereto in any convenient manner as by securing screws.

In order to provide a visual indication when the apparatus is energised, which is a generally-recommended safety requirement for fan heaters of this character, a pilot lamp 29 (Figure 5) may be mounted to extend through the wall of the duct at about its centre portion opposite the motor 7. The light illuminates the interior of the duct and can be seen through the grille 2.

The switches, as is usual with apparatus of this character, may be arranged to provide energisation of the apparatus, for different blower speeds, and for different degrees of heat, the electrical arrangement being preferably such that the heater cannot be energised unless the blower is working.

As an indication of the compact nature of the embodiment described the outside dimensions of the casing are approximately $9\frac{3}{4}$" long by $5\frac{3}{4}$" high by $4\frac{3}{4}$". The heater has a loading of 2 kW and the blower, having fans of 4" diameter running at approximately 1300 r.p.m., delivers at least 40 cubic feet of air per minute. The temperature rise of the casing is negligible since the incoming air flows over practically the whole area of the duct. The motor and the shaft bearings are also adequately cooled by the air streams.

As mentioned above, under normal operation with the heater full on, there is little, if any, temperature rise inside the duct. However, if one or both inlets (or the outlet) become inadvertently partially or wholly blocked a serious rise in temperature of the heater and the casing might ensue. To guard against this eventuality a temperature-sensitive element, for example a bi-metal switch, may be mounted inside the duct at a suitable position and so connected electrically as to switch off the heater and/or the whole apparatus in the event of such a temperature rise. The switch is preferably of the manual reset type so that it does not automatically reset to its "on" position when the temperature drops to normal.

The relatively small size of the apparatus described is in part due to the fact that the fan driving motor is placed inside the duct. We have discovered that this does not, to any disadvantageous extent, interfere with the air flow in the duct.

The invention is not, however, limited to the arrangement since the motor may be placed outside the duct at one end thereof or in certain cases two motors may be provided each driving one fan.

It will be understood that the above-described apparatus is only one example of the use of a blower according to the invention which may be used for other purposes. Further, it will be clear that the velocity of the exit stream is dependent to some extent on the area of the throat and this in turn will depend upon the length of the duct and the spacing of the fans. The duct need not, as in the described embodiment, have a substantially constant cross-section but may, for example have flared inlet and/or outlet ports. More than one exit throat may be provided, for example when a "bleed-off" supply is required independent of the main gas discharge. In such case the extra throat will preferably be arranged substantially tangentially as with the main throat.

WHAT WE CLAIM IS:—

1. A blower comprising a duct having a semi-cylindrical portion and a portion defining an outlet throat extending along the whole or substantially the whole of the length of the duct, two spaced co-axial fans mounted for rotation co-axially with the semi-cylindrical portion of the duct and each adjacent an end of the duct for producing two gas streams each of which has a combined longitudinal and rotational movement, the rotational movements being in the same sense and the longitudinal components to-

wards one another, the combined streams leaving the duct substantially tangentially to the said two gas streams through the outlet throat, and at least one prime mover for rotating the fans in the same direction.

2. A blower as claimed in Claim 1 wherein the prime mover is an electric motor disposed substantially centrally in the duct between the fans.

3. A blower as claimed in Claim 2 comprising a motor-fan assembly wherein each fan is carried on a half-shaft journalled in a bearing carired by a supporting structure secured to the motor, each half-shaft being resiliently coupled to the motor shaft.

4. A blower as claimed in Claim 3 wherein the motor-fan assembly is mounted within the duct by means securing the motor to the duct.

5. A blower as claimed in Claim 4 wherein said securing means incorporates a resilient member or members.

6. A space heater having a blower as claimed in any one of Claims 1 to 5 having a heating element or elements disposed in the outlet stream.

7. A space heater as claimed in Claim 6 having manually-operable switch means for selectively energising the motor and one or more of said heating elements, the arrangement being such that the heating element or elements cannot be energised unless the motor is energised.

8. A space heater as claimed in Claim 6 or Claim 7 having a temperature-sensitive switch responsive to the temperature in the duct for switching off the current supply to the heater element or elements or the heater and the motor if the air flow through the duct is impeded for any reason.

9. A space heater as claimed in Claims 6, 7 or 8 having a lamp disposed within the duct and electrically connected to indicate by its illumination when the apparatus is energised.

10. A blower substantially as described with reference to Figures 2, 3 and 4 of the accompanying drawings.

11. A space heater substantially as described with reference to Figures 1 to 8 of the accompanying drawings.

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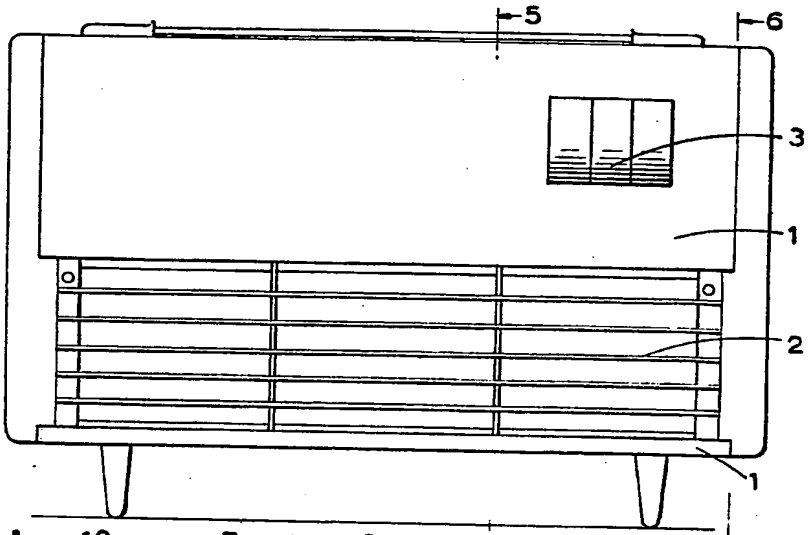
996056 COMPLETE SPECIFICATION

3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

FIG. 1.



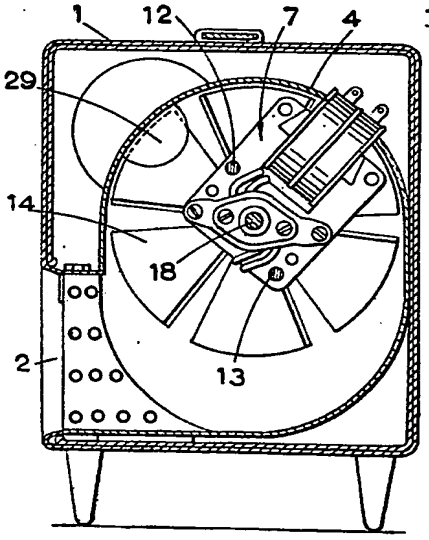


FIG. 5.

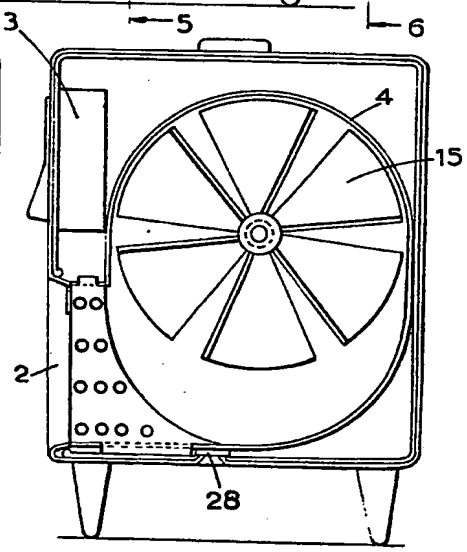


FIG. 6.

FIG. 3.

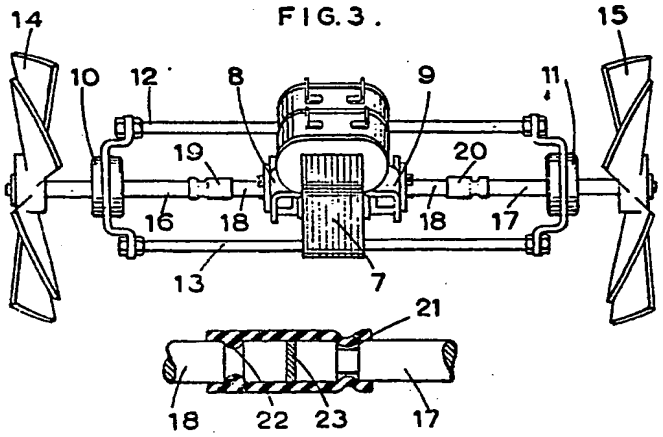
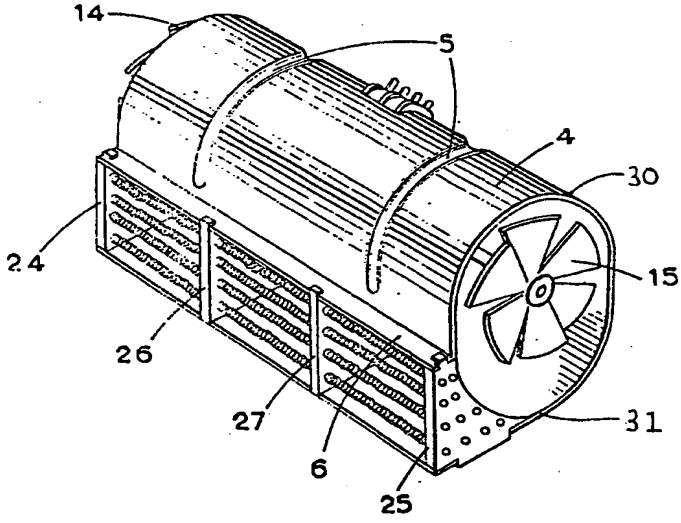


FIG. 4.

FIG. 2.



996056 COMPLETE SPECIFICATION
3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheets 2 & 3

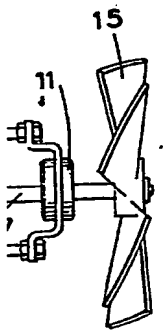


FIG.7.

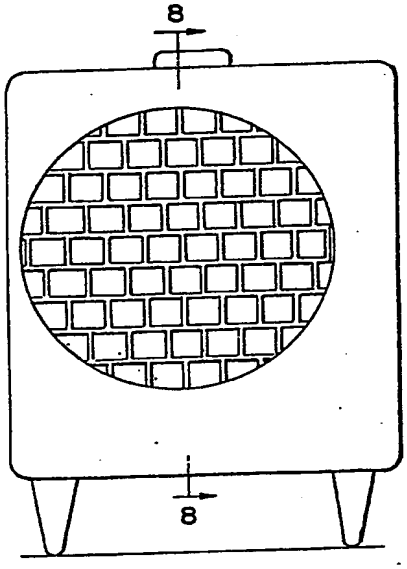
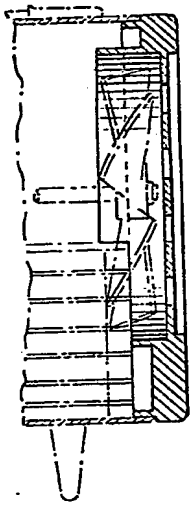
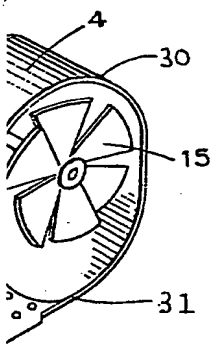


FIG.8.





996056 COMPLETE SPECIFICATION
3 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheets 2 & 3

FIG. 3.

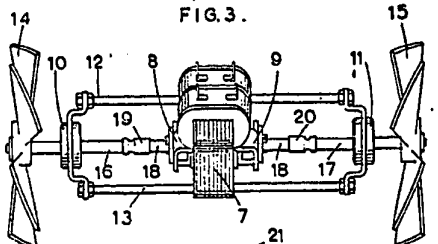


FIG. 4.

FIG. 2.

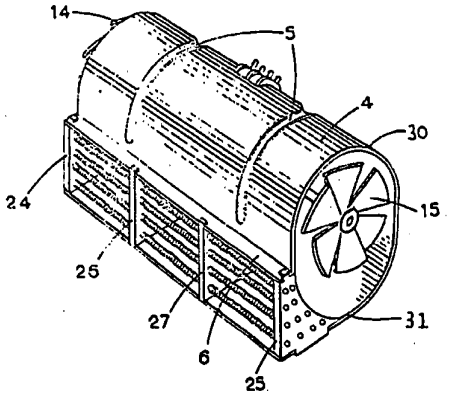


FIG. 7.

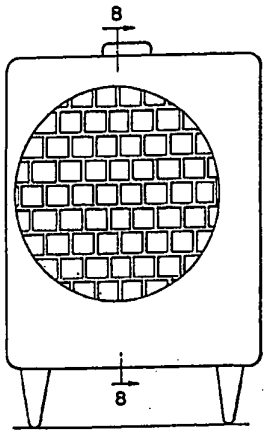


FIG. 8.